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CLAIMS:

(65)

1. A microfabricated device for fragmenting nucleic acids present in a fluid sample, the device comprising an 5 inlet port, a fragmentation cell, and an outlet port downstream from said inlet port, said cell being in fluid communication with said ports, and wherein said outlet port is dimensioned to impede the flow of a fluid sample out of said cell so as to effect shearing of nucleic acids 10 molecules therein, wherein the fragmentation cell comprises a chamber having a bottom wall in which is formed the outlet port, the bottom wall being generally perpendicular to the direction of flow of fluid through the outlet port, and wherein the fragmentation cell has a top wall in which 15 the inlet port is formed, and side walls which extend from the top wall to the bottom wall, and wherein the side walls taper inwardly to meet the inlet port.

2. A microfabricated device as claimed in claim 1, 20 wherein the fragmentation cell has the shape of an irregular polygon, preferably an irregular hexagon, with an essentially straight bottom wall in which the outlet port is formed at approximately the mid point, and wherein the bottom wall is substantially perpendicular to the 25 longitudinal axis of the outlet port.

3. A microfabricated device as claimed in claim 1, wherein the fragmentation cell is generally pear shaped with an essentially straight bottom wall in which the outlet port 30 is formed at approximately the mid point, the bottom wall being substantially perpendicular to the longitudinal axis of the outlet, and wherein the bottom wall is connected by

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curved walls to side walls, which converge or taper inwardly to meet the inlet port.

4. A microfabricated device as claimed in any one of
5 the preceding claims, wherein the width of the fragmentation
cell abruptly decreases at the outlet port.

10 5. A microfabricated device as claimed in any one of
the preceding claims, wherein the outlet port comprises a
constriction, preferably having a width in the range of from
1 to 100 μm , more preferably from 5 to 50 μm .

15 6. A microfabricated device as claimed in any one of
claims 1, 4 and 5, wherein the outlet port is formed in
approximately the middle of the bottom wall.

20 7. A microfabricated device as claimed in any one of
claims 1, 2 and 4 to 6, wherein the side walls taper
inwardly to meet the outlet port.

25 8. A microfabricated device as claimed in any one of
claims 1, 2 and 4 to 7, wherein the bottom wall is adjacent
and substantially perpendicular to two lower side wall
portions.

25 9. A microfabricated device as claimed in claim 8,
wherein the upper portions of the side walls taper inwardly
to meet the inlet port.

30 10. A microfabricated device as claimed in any one of
claims 1, 2 and 4 to 9, wherein side walls or portions
thereof next to or adjacent the inlet port subtend an angle

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of less than 90 degrees to the longitudinal axis of the inlet port.

11. A microfabricated device as claimed in any one of
5 claims 1 and 4 to 6, wherein the fragmentation cell
comprises a bottom wall in which the outlet port is formed
at approximately the mid point, the bottom wall being
substantially perpendicular to the longitudinal axis of the
outlet, and side walls which converge or taper inwardly to
10 meet the inlet port.

12. A microfabricated device as claimed in any one of
the preceding claims, wherein the device further comprises
an obstacle located in the cell in the direct path between
15 the inlet and outlet ports.

13. A microfabricated device as claimed in claim 12,
wherein the space between sides of the obstacle and sides of
the cell defines a bifurcated path for the fluid sample.

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14. A microfabricated device as claimed in claim 12 or
claim 13, wherein the obstacle is shaped so that the flow
path of a fluid sample in a region adjacent the outlet port
is substantially perpendicular to the longitudinal axis of
25 the outlet.

15. A microfabricated device as claimed in any one of
claims 12 to 14, wherein the obstacle is in the form of a
generally triangular obstacle, with its three sides
30 substantially parallel to the bottom wall and side walls of
the cell, the space between the sides of the obstacle and

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the sides of the cell defining a bifurcated path for the fluid sample.

16. A microfabricated device as claimed in any one of
5 the preceding claims, wherein the fragmentation cell is
asymmetric about the horizontal axis and substantially
symmetric about the longitudinal axis, the longitudinal axis
being essentially coincident with the direction of flow.

10 17. A microfabricated device as claimed in any one of
the preceding claims, further comprising an access channel
in fluid communication with the inlet port.

15 18. A microfabricated device as claimed in any one of
the preceding claims, further comprising collection means in
fluid communication with the outlet port.

20 19. A microfabricated device as claimed in any one of
the preceding claims, further comprising means for effecting
flow of a sample into the inlet port, through the
fragmentation cell and out of the outlet port.

25 20. A microfabricated device as claimed in claim 19,
wherein said means for effecting flow comprises one or more
pumps.

21. A microfabricated device as claimed in claim 19,
wherein said means for effecting flow comprises one or more
variable volume chambers in communication with the inlet
30 port and/or outlet port, wherein altering the volume of the
variable volume chamber(s) effects and/or restricts flow of
a fluid sample into and/or out of the fragmentation cell.

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22. A microfabricated device as claimed in any one of the preceding claims which comprises a substrate and an overlying cover, the fragmentation cell being defined by a 5 recess in a surface of the substrate and the adjacent surface of the cover.

23. A microfabricated device as claimed in claim 22, wherein the substrate is formed from silicon and the 10 overlying cover from glass.

24. A microfabricated device as claimed in claim 23, wherein the glass cover is anodically bonded to the silicon substrate, optionally through an intermediate silicon oxide 15 layer formed on the surface of the substrata.

25. A microfabricated device as claimed in any one of the preceding claims which comprises at least first and second fragmentation cells, the outlet port of the first 20 cell being in fluid communication with the inlet port of the second cell.

26. A microfabricated device as claimed in claim 25, further comprising a third fragmentation cell, the outlet 25 port of the second cell being in fluid communication with the inlet port of the third cell.

27. A microfabricated device as claimed in claim 25 or claim 26 comprising a plurality of serially connected 30 fragmentation cells.

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28. A microfabricated device as claimed in any one of claims 25 to 27, wherein the size of the outlet port decreases the further down stream the fragmentation cell.

5 29. A microfabricated device as claimed in claim 28, wherein the size of the outlet port gradually decreases from the first fragmentation cell to the last fragmentation cell downstream.

10 30. A microfabricated device as claimed in any one of the preceding claims for fragmenting nucleic acids present in a biological fluid, a dairy product, an environmental fluid or drinking water.

15 31. A microfabricated reaction chamber system for carrying out a nucleic acid sequence amplification and detection process on a nucleic acid sample, the system comprising a microfabricated device as defined in any one of the preceding claims.

20 32. An apparatus for the analysis of biological and/or environmental samples, the apparatus comprising a device as defined in any one of claims 1 to 30 or a system as defined in claim 31.

25 33. An assay kit for the analysis of biological and/or environmental samples, the kit comprising a device as defined in any one of claims 1 to 30 or a system as defined in claim 31 and means for contacting the sample with the 30 device.

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34. An apparatus as claimed in claim 32 or an assay kit as claimed in claim 33 which is disposable.

35. A process for fragmenting nucleic acids present in 5 a fluid sample, the process comprising:

- (a) providing a device as defined in any one of claims 1 to 30 or a microfabricated reaction chamber system as defined in claim 31 or an apparatus as defined in claim 32 or an assay kit as defined in claim 33;
- 10 (b) providing a fluid sample comprising nucleic acids;
- (c) pumping the fluid sample into the inlet port of said device, through the fragmentation cell and out of the outlet port; and
- 15 (d) collecting the thus fragmented sample at the outlet port.

36. A process as claimed in claim 35 which further involves a nucleic acid sequence amplification and detection process on the fragmented nucleic acid sample.

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